Multiparameter Interpretive Reporting in Diagnostic Hematology

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To be of maximum benefit to physicians and patients, the modern, hematology laboratory must be prepared to provide a number of other services beyond automated complete blood counts and routine morphology. The hemogram and peripheral blood smear are valuable screening procedures. Proper interpretation of peripheral blood abnormalities leads to a working differential diagnosis and suggests which complementary tests should be performed to arrive at a diagnosis with the minimum cost, delay, and discomfort to the patient.

Hematologic malignancies must be accurately classified since important therapeutic decisions are based on the diagnosis. Reliable classification of acute leukemias and lymphoproliferative disorders cannot be achieved by routine morphology alone. Hematopoietic cells have characteristic phenotypes based on membrane and intracellular antigen detection by flow cytometry (FCM). DNA ploidy analysis along with cell cycle kinetic studies are also extremely valuable in the diagnosis of non-Hodgkin's lymphomas. A complete diagnostic consultation in a patient with hematologic disease should include evaluation of the pertinent clinical history as well as correlation of appropriate laboratory tests and all of the available morphologic and immunologic information.

We have designed and tested three interactive knowledge-based systems for use in the hematology laboratory: 1) "Professor Petrushka" [1] (Peripheral blood analysis); 2) "Professor Fidelio" [2] (FCM immunophenotyping and DNA content interpretation); and, 3) "Professor Belmonte" [3] (Bone marrow morphology). The systems run on IBM-compatible hardware under Windows 3.1. A database [4], which includes relevant clinical history and general laboratory tests, is an integral part of the systems and serves as a means of communication between the modules for multiparameter interpretive reporting.

All of the modules use the heuristic classification method as defined by Clancey [5]. The input data are matched with diagnostic pattern definitions after abstraction. The diagnostic patterns are exhaustive but not mutually exclusive. Heuristics are applied to reduce the conflict set to one predominant pattern or, in the case of the FCM system, to eliminate patterns which are not totally excluded by the data (because the antibodies defining these patterns were not tested on the specimen).

The peripheral blood system, which is interfaced to state-of-the art COULTER® hematology analyzers, lists a differential diagnosis and makes suggestions for appropriate clinical history and laboratory tests. With the help of the database, the program is capable of intelligent follow-up on patients whose specimens have been seen previously in the laboratory.

The FCM system uses the database to determine the percentage of blasts and the types of abnormal mononuclear cells before rendering an interpretation. The bone marrow module writes a multiparameter report including evaluation of the peripheral blood and FCM immunophenotyping. The systems are complemented by an electronic textbook with an atlas of digitized photomicrographs.

References

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